Firmware Integration Technology

User's Manual

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Introduction

Firmware Integration Technology (FIT) is a global set of Renesas standards enabling creation of quality, easy-to-use, inter-operable firmware. This document will give specific information on what FIT is, how it works, and how to use FIT code with your own application code.

Target Device

RX Family

When using this application note with other Renesas MCUs, careful evaluation is recommended after making modifications to comply with the alternate MCU.

Related Documents

- Board Support Package Using Firmware Integration Technology Module (R01AN1685EU0230)
- Adding Firmware Integration Technology Modules to Projects (R01AN1723EU0100)

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1. Overview

1.1 Terminology

The following terms will be used throughout the rest of this document.

Term	Meaning
Module	The core unit of FIT. Modules can be peripheral drivers, purely software (i.e. middleware), or anything in between. Each Module consists of a folder with source code, documentation, and anything else that the user needs to use the code effectively. Modules are independent units, but they may depend on other FIT Modules. FIT Modules are designed to work together out-of-the-box. Example FIT Modules could be: • UART driver • MMC protocol code (relies on separate SPI driver Module) • Low power mode controller • MP3 decoder/encoder software Applications can be built by combining multiple FIT modules with user application code to provide the users with the features they need.
Platform	The user's development board. Used interchangeably with 'board'.
BSP	Short for Board Support Package. BSP's usually have source files related to a specific board.
r_bsp	Renesas provided Board Support Package FIT Module. Provides a common foundation of code, for a variety of boards and MCUs, upon which FIT Modules and user application code can be built. See Section 2 for more information.
Callback Function	This term refers to a function that is called when an event occurs. For example, the bus error interrupt handler is implemented in the r_bsp. The user will likely want to know when a bus error occurs. To alert the user, a callback function can be supplied to the r_bsp. When a bus error occurs the r_bsp will jump to the provided callback function and the user can handle the error. Most callbacks in FIT Modules occur from within Interrupt Service Routines (ISRs), which means other interrupts in the system may be delayed while processing the callback. Because of this, user created callback functions should be kept as short as possible.

1.2 What is FIT?

Firmware Integration Technology is an agreed upon set of rules that all Renesas developers follow when writing FIT code. Users may follow the FIT rules if they want, but there is no requirement for them to apply any of the FIT rules to their own code. Key items that are addressed by the FIT rules are:

- Easy insertion into user's existing project
- Integrating multiple modules
- Simple, one file configuration
- Common documentation practices
- Common file and directory structure
- Strong foundation to build code on top of
- Mixture of compile-time and run-time configuration options

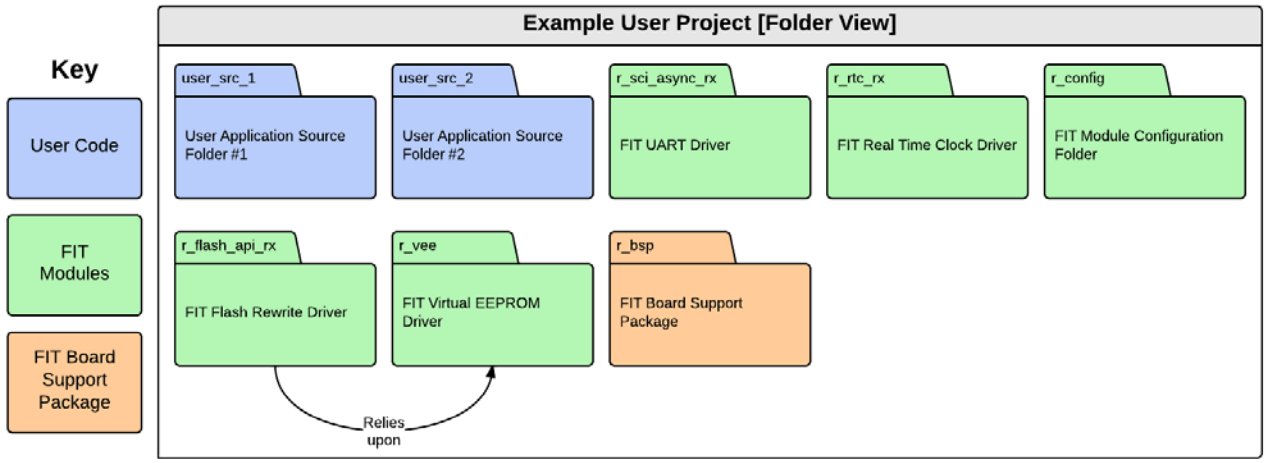
1.3 Why is FIT needed?

Microcontrollers continue to evolve and become more complex. In order to be able to use all the new and advanced peripherals that are available, the software needed to evolve as well. FIT fills this need by offering advanced software while exposing a simple API to the user.

1.4 What does a FIT project look like?

A user's project that uses FIT will typically have 3 parts.

1. User Application Code:
   Includes all code written by user such as application code and custom drivers.
2. FIT Modules:
   Multiple FIT modules; each of which provides its own individual features and functions. Examples include peripheral drivers and software middleware. FIT Modules can be dependent upon other FIT modules as shown in the example.
3. FIT Board Support Package:
   Board support package for the user's custom board. The r_bsp is technically a FIT module too, but it is shown separately here because it is the lowest layer that all other FIT modules depend on.



2. Board Support Package

The foundation of any project that uses FIT modules is the Renesas Board Support Package, abbreviated as *r_bsp*. The *r_bsp* provides a common starting point for all projects, and is a baseline requirement for all FIT modules. It is responsible for getting the MCU from reset to the user application's main() function. The *r_bsp* contains startup code for a specific platform, such as early pin initialization and clock setup, and a base set of common MCU-specific services such as setting the global interrupt level, I/O register definitions, and resource locking primitives. Many MCUs are supported, and the *r_bsp* is meant to be modified for use with the user's custom board. Choosing a particular board from the *r_bsp* is done through the *platform.h* header file. Configuration of the *r_bsp* is completed through a single header file *r_bsp_config.h*.

2.1 Features

Most Renesas MCUs can be configured in many ways on reset. Knowing all of the configuration options and how to set them can be a daunting task; especially for a new user. The *r_bsp* makes this easier by supplying the user with a known good default configuration that can easily be modified. Typical features of the *r_bsp* include:

1. Clock setup and configuration
2. Stack initialization
3. Setup of MCU exceptions with callbacks for events
4. Support for security features (e.g. flash access protection)
5. Provides API functions for common CPU tasks
6. Makes information about the current MCU and board available to FIT modules and the user
7. Many more...

For much more information on the *r_bsp*, including a complete list of the features, how to add it to your project, and how to make your own custom BSP, please reference the ‘Board Support Package FIT Module’ application note (R01AN1685EU).

2.2 Using the r_bsp in Application Code

After the *r_bsp* FIT Module has been added to a project, all of its API functions, types, and macros can be accessed from your application code by including the *platform.h* file. *platform.h* must always be included before any other FIT Modules. For example, if your source file uses the *r_gpio_rx*, *r_sci_async_rx*, and *r_s12ad_rx* Modules then its includes would look like this:

```
/* platform.h must always be included first. */
#include "platform.h"
/* The order of these FIT Module includes does not matter. */
#include "r_gpio_rx_if.h"
#include "r_sci_async_rx_if.h"
#include "r_s12ad_rx_if.h"
```

3. Module File Structure

FIT rules define the file structure for all Modules. Having common directory structures and file naming conventions makes it easier for users to quickly find what they need. The required file structure is shown below.

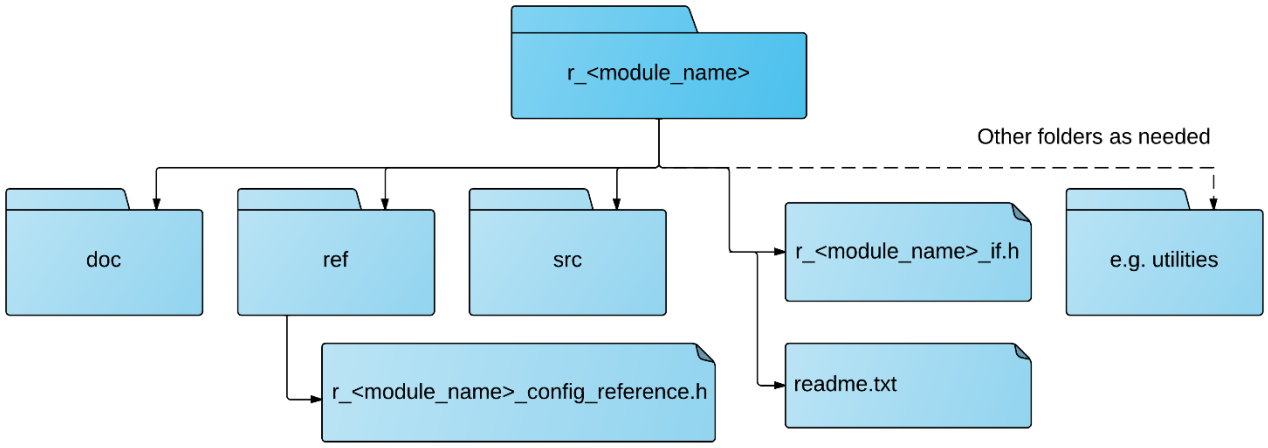


Figure 1 : FIT Module File Structure

Examples of r_<module_name> include:

- r_bsp (Renesas Board Support Package)
- r_adc_rx (Analog-to-Digital Converter driver)
- r_sci_async_rx (Asynchronous UART driver)
- r_flash_api_rx (Flash Rewrite driver)
- r_cgc_rx111 (Clock Generation Circuit driver)
- r_vee (Virtual EEPROM Project)

Notice that many of these Module names end with '_rx'. This is a postfix that is used to designate which MCUs this Module can, or will, support. In the case of using '_rx', this signifies that this Module supports all RX devices. Modules can be more specific as well. For example, the *r_cgc_rx111* module only supports the RX111. In the case that a Module does not have a MCU postfix, such as *r_vee*, this means that it is not MCU dependent. The *r_vee* is the Virtual EEPROM Project and is purely software; therefore it can support any MCU.

Each required folder and file is explained in more detail in the following sections.

3.1 Documentation Folder ('doc')

This is folder holds all of the documentation for the Module. At a minimum the Module's application note will be in this folder.

3.2 Reference Configuration Folder ('ref')

An important feature of FIT is that all of a Module's compile-time options are contained in one header file. A reference version of this configuration is stored in the Module's 'ref' (stands for 'reference') folder. One required task when adding a FIT Module to a project is to copy the Module's reference configuration file, paste it into the *r_config* folder, and remove the '_reference' portion of the filename. Users are encouraged to put all of their configuration files in one folder. By default, the *r_config* folder name is used. By putting all configuration files in the same folder it makes it easy for users to find them and requires only one include path to be setup. It also allows for easy back up in a version control system.

A reference configuration file is supplied so that users always have a known good configuration file in the event that their custom configuration file is deleted or corrupted.

3.3 Source Folder (‘src’)

All MCU source code for a FIT Module is stored in the *src* folder. There can be multiple source folders underneath this folder if needed. FIT Modules that support multiple MCUs might have a *targets* folder. Inside of this folder users will find ports for different MCUs or peripheral versions. Figure 2 shows an example in which a FIT Module has ports for all RX11x, RX21x, and RX63x MCUs. The ‘x’ character in the name is used as a wildcard. The *rx63x* folder means that it will support the RX63N, RX631, RX63T, etc. If users are only using one target folder then they can delete the other unused folders. For example, if the user is developing using an RX111 then they can delete the *rx21x* and *rx63x* folders.

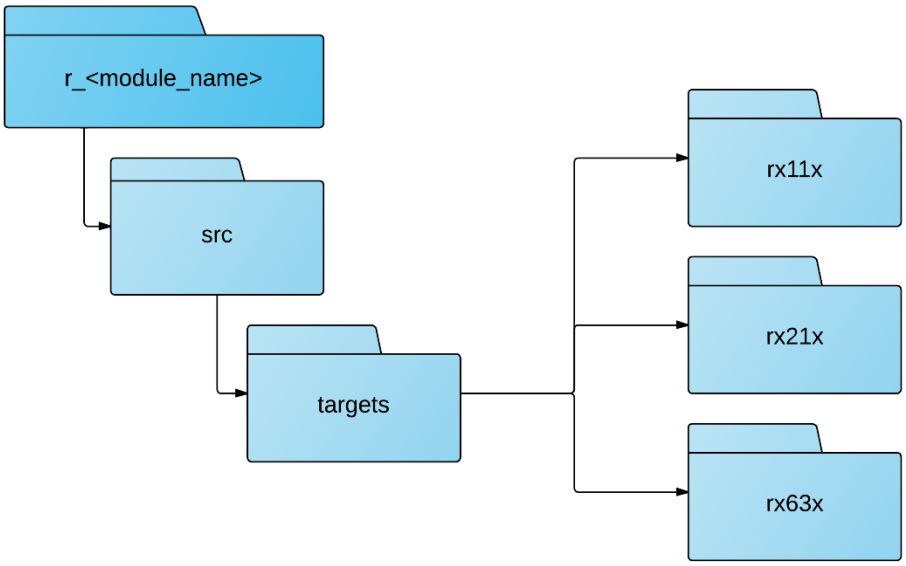


Figure 2 : FIT Module with 'targets' Folder

3.4 Interface Header File (‘r_<module_name>_if.h’)

The interface header file is the one header file that the user will need to #include in their code to use a FIT Module. In this way the file is an *interface* to the FIT Module. The interface header file will have all the needed API function prototypes, data structures, and macros required to use the Module. The naming of the interface file starts with the same name as the Module with ‘_if.h’ appended.

3.5 readme.txt

The *readme.txt* file is a simple text file that can be quickly referenced to find important information about a FIT Module. Information in this file includes:

- Module Name
- Renesas Document Number
- Version
- Overview
- Features
- Supported MCUs
- Boards Tested On
- Limitations
- Peripherals Used Directly
- Dependencies (other FIT Modules that are required for this one to work)
- How to Add to Your Project
- Toolchain(s) Used
- File Structure

3.6 Other Folders

All of the files and folders in Figure 1 are mandatory except for the *utilities* folder which has a dotted line. The *utilities* folder is an example of extra collateral that can be included with a FIT Module. For example, some modules might come with code that needs to be run on a PC. This code could be included with the Module in an extra directory. Another example is a Module that comes in library form. This module could have a folder named *lib* which would contain the library.

4. Using FIT Modules

4.1 Adding FIT Modules to a Project

Since FIT Modules follow a standard file structure, the steps to add most Modules to a project are very similar. The basic steps that are always required are:

1. Copy the FIT Module to your project (or wherever you want it to reside).
2. Add *r_<module_name>* and *r_<module_name>/src* to the project's include path.
3. Add all source code underneath the *r_<module_name>* to the project (ensure it is built).
4. Create a folder named *r_config* if one does not already exist and add it to the project's include path.
5. Copy the reference configuration header file, from *r_<module_name>/ref*, to the *r_config* folder.
6. Remove the '_reference.h' from the configuration file that was just copied to the *r_config* folder.

Reference the *readme.txt* or application note for a Module to see the required steps for that specific module.

4.2 e^2 studio Plug-in

Renesas provides a plug-in that integrates with e^2 studio which automates the process of adding a FIT Module to a project. The plug-in takes care of all the steps listed in Section 4.1, and it handles additional tasks like automatically inserting other FIT modules when needed. For information on using the plug-in, please reference the 'Adding FIT Modules to Projects' application note (Renesas Document Number: R01AN1723EU0100).

4.3 Using the Module's API

After a FIT Module has been added to a project, users need to perform the following steps to use it in their application code:

1. Open the Module's configuration file (in the *r_config* folder) and review the file for any changes that are required for the current project. Making changes to a configuration file typically involves changing the value of #define macros. In some cases commenting out, or uncommenting a #define might be required as well.
2. Add a #include for *platform.h* and the Module's interface header file to any source file that needs to access the Module.

The header file *platform.h* comes from the *r_bsp* and it must be modified by the user to choose which board they are currently using. Including *platform.h* is required before including any other FIT Modules. The reason for this is that *platform.h* brings in all FIT foundation information that all FIT Modules use.

All users are recommended to review the Module's application note and interface header file before use so that they are aware of all available data structures and functions. The application note is located in the Module's *doc* folder.

FIT Modules are typically designed to use the Open(), Close(), Read(), Write(), Control() functional paradigm. In this setup:

- Open() is used to power on the peripheral and perform initial configuration
- Close() is used to disable and power down the peripheral
- Read() is used to get data from the Module (e.g. read ADC)
- Write() is used to supply data to the Module (e.g. write byte to UART)
- Control() takes a command and is used to perform various tasks that expand the functionality of the API without cluttering the API with many small functions. One of the main benefits of the Control() function is that the commands can be extended without altering the Module's API. An example of a Control() function in use would be to have a command that would abort an on-going transmission with a UART driver.

4.4 Interrupt Handling

FIT Modules handle peripheral interrupts internally. Users are alerted of interrupts in one of two ways. One way is through the use of callback functions. When using this method the user is required to supply a function address to the FIT Module. When the interrupt occurs the FIT Module will call the function that was provided by the user. When this method is used users should be very careful of what they put in the callback function. The function will be called from within an interrupt service routine. If the callback function takes a relatively long period of time to execute, then it can lengthen the response time of your system.

The other option is to poll for interrupt completion using a Module API function. This method has the benefit of not being called from within an interrupt service routine, but requires the user to check the Module on a regular basis.

Many FIT Modules will have the option of using callbacks or polling. When polling is desired and the API still requires a callback function address the user is encouraged to use the FIT_NO_FUNC macro that is defined in the *r_bsp*. Using

this macro has the benefit on RX MCUs that it is defined as an address to undefined memory that will cause a bus error which can be detected and handled by the *r_bsp*. Users can also use the common NULL macro, but since it is typically defined to 0, which is a valid RAM address on the RX, it can be harder to detect when used incorrectly.

4.5 Parameter Checking

All FIT Modules contain a macro in their configuration files that pertains to parameter checking. This macro will always end with '*CFG_PARAM_CHECKING_ENABLE'* and by default will be set to use the macro *BSP_CFG_PARAM_CHECKING_ENABLE*. This macro is defined in the *r_bsp* and allows the user to globally enable or disable parameter checking. You can locally override the global setting by setting the macro in the Module.

```
/***********************************************************************************
Configuration Options
***********************************************************************************/
/* SPECIFY WHETHER TO INCLUDE CODE FOR API PARAMETER CHECKING
   Available settings:
   BSP_CFG_PARAM_CHECKING_ENABLE:
       Utilizes the system default setting
   1:
       Includes parameter checking
   0:
       Compiles out parameter checking
*/
#define GPIO_CFG_PARAM_CHECKING_ENABLE      (BSP_CFG_PARAM_CHECKING_ENABLE)
```

When parameter checking is enabled FIT Modules will check all parameters input by the user to be valid. If a parameter is found to be invalid then an error code will be returned to the user. This is great for debugging, but it does take extra memory and execution time. Once development and testing is complete, some users may wish to disable parameter checking for a module. This reduces code size and execution time; however, if parameter checking is disabled, and an invalid parameter is input, then improper module operation will likely occur.

5. Tutorial

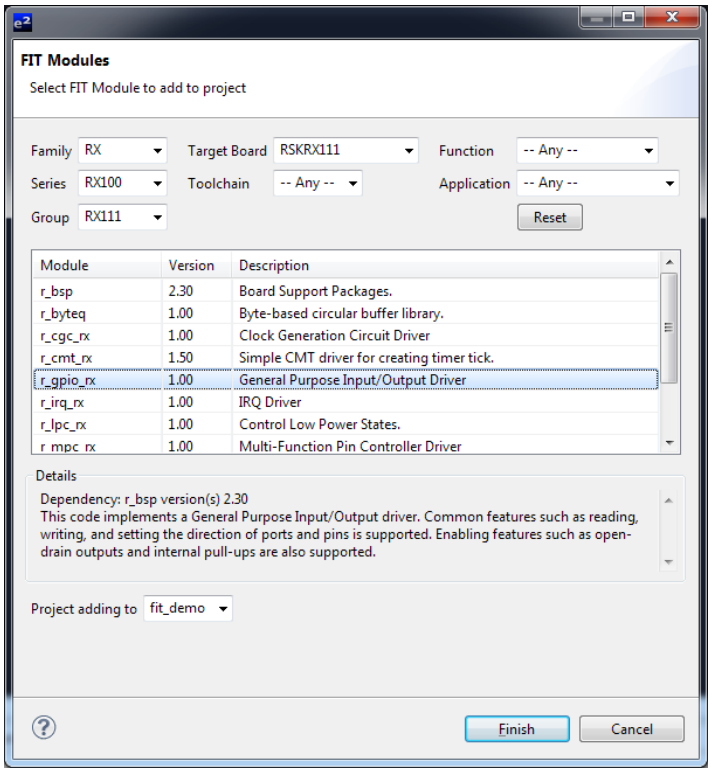
This section will lead the user through adding a FIT Module to a project that already has the r_bsp installed. This result will be a very simple demo, but the point of the exercise is to learn to use FIT Modules. For steps on how to create an empty project, and add the r_bsp to it, please reference the 'Project Setup' section in the Board Support Package FIT Module application note (R01AN1685EU0230).

The RSKRX111 will be used in this tutorial but the same steps should work for most boards by adjusting which pins are used.

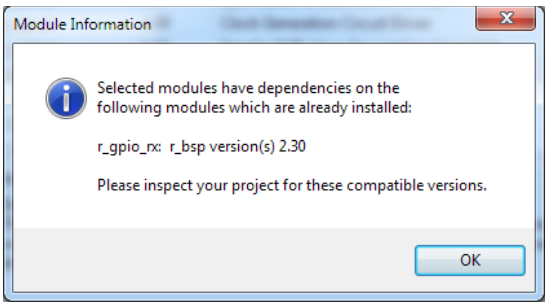
5.1 Blink a LED

In this section we will add the *r_gpio_rx* FIT Module. We will use this Module to control GPIO pins on the MCU and blink an LED. NOTE: This demo is for illustration purposes only; LED definitions do exist in the r_bsp that can access GPIO pins directly.

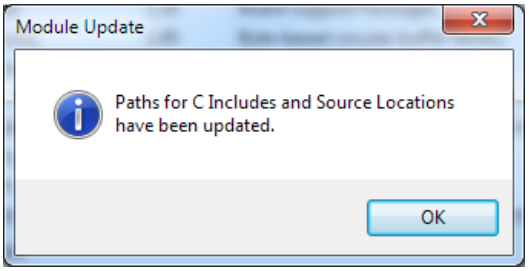
1. With your e^2 studio project open, click File >> New >> Renesas FIT Module.
2. Set the 'Family', 'Series', 'Group', and 'Target Board' filters for your board.
3. Choose *r_gpio_rx* from the Module list.
4. Select your project from the 'Project adding to' drop-down.


FIT Modules
Select FIT Module to add to project
Family RX
Target Board RSKRX111
Function -- Any --
Series RX100
Toolchain -- Any --
Application -- Any --
Group RX111
Reset
Module
Version
Description
r_bsp 2.30 Board Support Packages.
r_byteq 1.00 Byte-based circular buffer library.
r_cgc_rx 1.00 Clock Generation Circuit Driver
r_cmt_rx 1.50 Simple CMT driver for creating timer tick.
r_gpio_rx 1.00 General Purpose Input/Output Driver
r_irq_rx 1.00 IRQ Driver
r_lpc_rx 1.00 Control Low Power States.
r_mpc_rx 1.00 Multi-Function Pin Controller Driver
Details
Dependency: r_bsp version(s) 2.30
This code implements a General Purpose Input/Output driver. Common features such as reading, writing, and setting the direction of ports and pins is supported. Enabling features such as open-drain outputs and internal pull-ups are also supported.
Project adding to fit_demo
Finish
Cancel

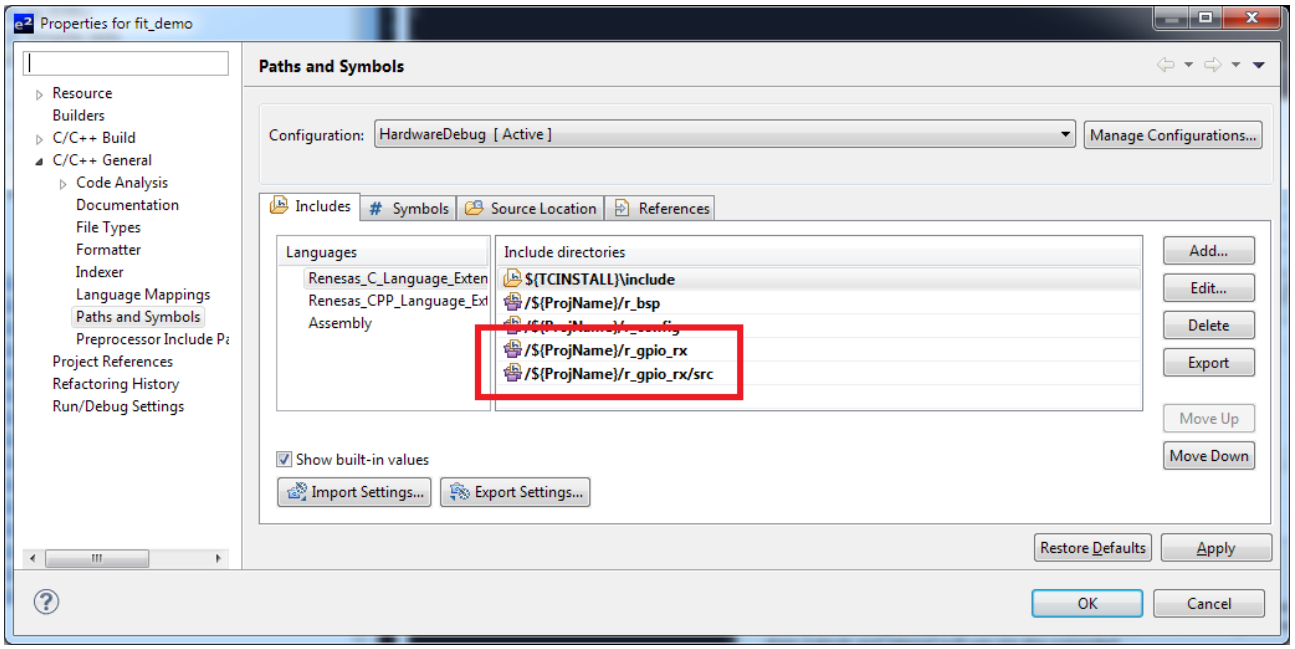
5. Click 'Finish'.
6. The plug-in will pop up a window stating that the *r_gpio_rx* module has a dependency upon *r_bsp v2.30* and that it appears this Module has already been installed. Click OK.


Module Information
Selected modules have dependencies on the following modules which are already installed:
r_gpio_rx: r_bsp version(s) 2.30
Please inspect your project for these compatible versions.
OK

7. The plug-in will pop up another window alerting you that the include and source paths for the project have been updated. Click OK.



8. A window will pop up showing you the include directories for your project. Verify that two include paths were added for the *r_gpio_rx* Module.



9. Click Apply and then click OK to close the window.
10. Verify in the Project Explorer pane that *r_gpio_rx* is now in your project. Underneath the *r_gpio_rx* folder you will see the *doc* folder which holds this Module's application note. The application note provides the user with all of the reference information needed for the Module. It also includes sample code that can be cut and pasted into the user's application.
11. Verify that the *r_gpio_rx* configuration file (i.e. *r_gpio_rx_config.h*) was copied to the *r_config* directory.
12. Open up the *r_gpio_rx_config.h* file to see the available compile-time options. In this case the only option is to enable or disable parameter checking. This is discussed in Section 4.5.
13. We can now use the *r_gpio_rx* Module in our application code. Open the source file that contains the application's main() function.
14. Add a #include for *platform.h* and the Module's interface file:

```
#include "platform.h"
#include "r_gpio_rx_if.h"
```

15. Open up the interface file from the *r_gpio_rx* folder and see the available types and functions. Notice the comment in the 'Typedef definitions' section.

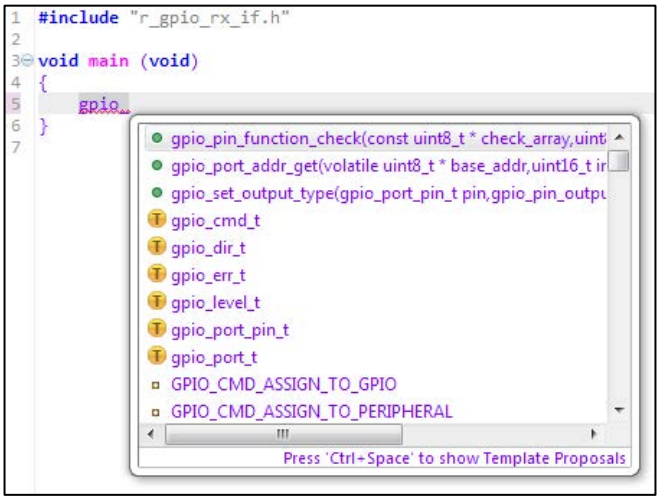
```
/* The gpio_port_t and gpio_port_pin_t enums are located in the 'targets' folder for
 * each MCU. For example, to see these enums for a RX111 look at the following file:
 * r_gpio_rx/src/targets/rx111/r_gpio_rx111.h
 */
```

Typically, all typdefs, enumerators, and structures are contained in the Module's interface file. For some FIT Modules that support multiple MCUs, these items will need to change depending on which MCU is chosen. To offer this capability, some items might be moved to the *targets* directory as is done here. The *r_gpio_rx* module supplies an enumerator for all of the available pins on a MCU. Obviously this enumerator will need to change depending on what MCU is chosen. This enumerator can even change depending on which pin and package option for a MCU is chosen.

16. Open up the *r_gpio_rx/src/targets/rx111/r_gpio_rx111.h* header file and examine the *gpio_port_t* and *gpio_port_pin_t* enumerators.
17. From looking at the interface file, we can get an overview of what functionality is provided by the FIT Module. If you need extra information remember that an application note is provided for all FIT Modules in the *doc* folder. For the *r_gpio_rx* module we may not need to reference the application note since the Module is fairly simple. Now that we have an idea of what is offered by the *r_gpio_rx* module let's turn an LED on. LED0 on the RSKRX111 is Port B Pin 7. This can be found from the schematic for the board, or it is commonly defined in the *r_bsp* as well. For the RSKRX111, this information could be found by viewing the LED0 macro found in *r_bsp/board/rskrx111/rskrx111.h*.

```
/* LEDs */
#define LED0                PORTB.PODR.BIT.B7
```

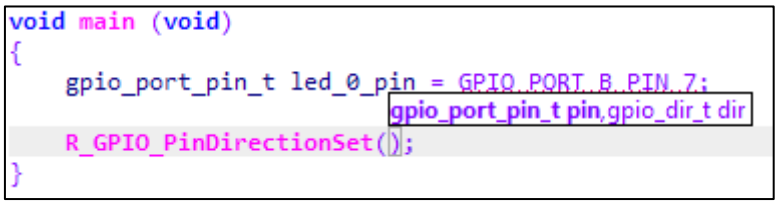
18. To control the port pin we will need to set the pin as an output and then drive it in a certain direction. The LEDs on the RSKRX111 board have pull-ups on them so to turn on the LED we will need to drive the pin low. According to the Module's application note we will need to use the R_GPIO_PinDirectionSet() and R_GPIO_PinWrite() functions. Both of these functions take a *gpio_port_pin_t* type for the pin so let's go ahead and define a variable for LED0. In your main() function type 'gpio_' and then press 'Control + Space'. A helper window should pop-up that looks similar to this:



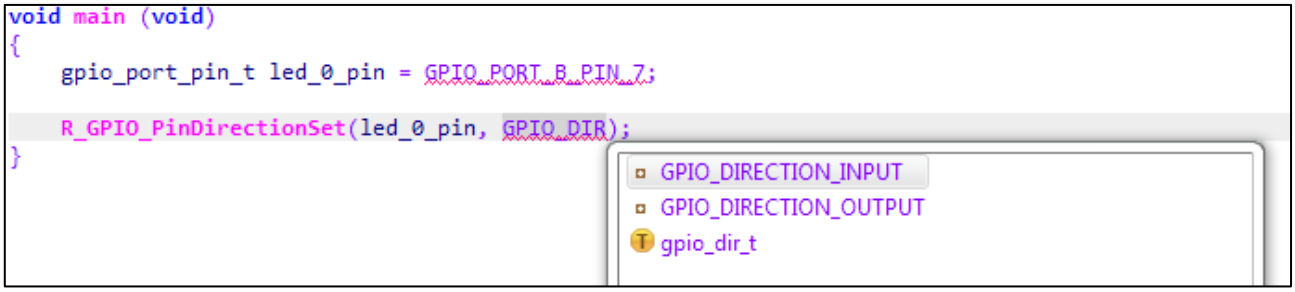
This is a very helpful feature in e² studio called autocomplete. The way this works is that e² studio will scan your project and give you a list of possible completions to what you have already typed. Since FIT Modules follow specific naming conventions, it is very easy to find what you need quickly. Press the down key on your keyboard, or click with your mouse, and select *gpio_port_pin_t*. Notice that e² studio proceeds to autocomplete the variable type. Name the variable *led_0_pin* and assign it to GPIO_PORT_B_PIN_7.

```
void main (void)
{
    gpio_port_pin_t led_0_pin = GPIO_PORT_B_PIN_7;
}
```

19. We will now set the pin to be an output using the R_GPIO_PinDirectionSet() function. Type 'R_GPIO' in the editor and then hit 'Control + Space' again. Notice that the autocomplete window pops up again and this time it lists all of the available API functions. Choose the R_GPIO_PinDirectionSet() function from the list. Notice that once the function name has been filled in, e² studio also shows the names and types of the variables that need to be used.



20. For the *pin* argument type in our variable *led_0_pin.*
21. For the *dir* argument type in 'GPIO_DIR' and press 'Control + Space'. Choose *GPIO_DIRECTION_OUTPUT* from the autocomplete list. You are probably wondering how we knew to start with 'GPIO_DIR'. Once again we are following FIT naming conventions. Enumerator values follow the name of the typedef. In this case the type is ***gpio_dir**_t* so we start typing that name in all caps and use the autocomplete feature to see the available options.



22. Now that the pin is set as an output, let's set it low to turn on the LED on. We will use the R_GPIO_PinWrite() function for this. Go ahead and type 'R_GPIO' and then hit Control + Space to autocomplete the function name.
23. The 1st argument is once again the pin, *led_0_pin*, and the 2nd argument is the direction which is represented by the *gpio_level_t* type. Type 'GPIO_LEVEL' and hit Control + Space to see the available options. The options will be GPIO_LEVEL_HIGH and GPIO_LEVEL_LOW. We want to set the pin low so choose GPIO_LEVEL_LOW.
24. Add a while(1) infinite loop. Your code should look like the following:

```
/* platform.h must be included first. */
#include "platform.h"
#include "r_gpio_rx_if.h"

void main (void)
{
    gpio_port_pin_t led_0_pin = GPIO_PORT_B_PIN_7;

    R_GPIO_PinDirectionSet(led_0_pin, GPIO_DIRECTION_OUTPUT);

    R_GPIO_PinWrite(led_0_pin, GPIO_LEVEL_LOW);

    while(1)
    {
        /* Infinite loop. */
    }
}
```

25. Build the code, and debug it. LED0 should be on.
26. To blink the LED we'll need to use the R_GPIO_PinRead() function. Use the same methods as before, mainly the autocomplete feature, to read the pin and set it based on the result.
27. Add a for() loop for delay purposes to make sure we can see the LED blink.

```
/* platform.h must be included first. */
#include "platform.h"
#include "r_gpio_rx_if.h"

void main (void)
{
    uint32_t i;

    gpio_port_pin_t led_0_pin = GPIO_PORT_B_PIN_7;

    R_GPIO_PinDirectionSet(led_0_pin, GPIO_DIRECTION_OUTPUT);

    R_GPIO_PinWrite(led_0_pin, GPIO_LEVEL_LOW);

    while (1)
    {
        for (i = 0; i < 500000; i++)
        {
            /* Delay so we can see the LED blink. */
        }

        if (GPIO_LEVEL_LOW == R_GPIO_PinRead(led_0_pin))
        {
            R_GPIO_PinWrite(led_0_pin, GPIO_LEVEL_HIGH);
        }
        else
        {
            R_GPIO_PinWrite(led_0_pin, GPIO_LEVEL_LOW);
        }
    }
}
```

28. Build the code and debug it. The LED should be blinking!

6. Frequently Asked Questions

6.1 What IDEs are supported by FIT?

FIT Modules, and FIT in general, are not tied to any specific IDE. The FIT Plug-in is currently only supported by e^2 studio.

6.2 What MCUs are supported by FIT?

The FIT specification can be applied to any MCU. Currently, FIT is only being implemented on RX MCUs.

6.3 What toolchains/compilers are supported?

Which toolchains are supported varies depending on which FIT Module is used. As a baseline requirement, all FIT Module will support the Renesas supplied toolchain. Other toolchains may be supported based upon requests, and the amount of work it takes to 'port' the code.

6.4 Where can I download FIT Modules?

FIT Modules can be downloaded from the Renesas website alongside other Renesas application notes. To identify a FIT Module look for the term 'FIT' in the name.

6.5 Does FIT provide RTOS support?

Currently FIT Modules are not tied to any RTOS, and do not supply direct RTOS support. However, FIT Modules are designed such that they do not prevent the user from using an RTOS with the Module.

The *r_bsp* provides atomic locking mechanisms in the event that the user wants to ensure safe access to shared resources, but does not want to use an RTOS. These mechanisms should be understood and used with care; when used improperly, they can cause deadlock in the application code. For more information on this feature, please reference the 'Board Support Package FIT Module' application note (R01AN1685EU).

6.6 Can I make my own FIT Module?

Absolutely. Users are encouraged to create their own FIT Modules that can then be used with the FIT Plug-in.

6.7 How do I request a new Module, feature, help, or anything else?

Please contact Renesas using the technical support email:

techsupport.america@renesas.com

Website and Support

Renesas Electronics Website
http://www.renesas.com/

Inquiries
http://www.renesas.com/inquiry

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Revision Record

		Description	
Rev.	**Date**	**Page**	**Summary**
1.00	Nov.15.2013	—	First edition issued

General Precautions in the Handling of MPU/MCU Products

The following usage notes are applicable to all MPU/MCU products from Renesas. For detailed usage notes on the products covered by this document, refer to the relevant sections of the document as well as any technical updates that have been issued for the products.

1. Handling of Unused Pins

   Handle unused pins in accord with the directions given under Handling of Unused Pins in the manual.

   — The input pins of CMOS products are generally in the high-impedance state. In operation with an unused pin in the open-circuit state, extra electromagnetic noise is induced in the vicinity of LSI, an associated shoot-through current flows internally, and malfunctions occur due to the false recognition of the pin state as an input signal become possible. Unused pins should be handled as described under Handling of Unused Pins in the manual.

2. Processing at Power-on

   The state of the product is undefined at the moment when power is supplied.

   — The states of internal circuits in the LSI are indeterminate and the states of register settings and pins are undefined at the moment when power is supplied.
   In a finished product where the reset signal is applied to the external reset pin, the states of pins are not guaranteed from the moment when power is supplied until the reset process is completed.
   In a similar way, the states of pins in a product that is reset by an on-chip power-on reset function are not guaranteed from the moment when power is supplied until the power reaches the level at which resetting has been specified.

3. Prohibition of Access to Reserved Addresses

   Access to reserved addresses is prohibited.

   — The reserved addresses are provided for the possible future expansion of functions. Do not access these addresses; the correct operation of LSI is not guaranteed if they are accessed.

4. Clock Signals

   After applying a reset, only release the reset line after the operating clock signal has become stable. When switching the clock signal during program execution, wait until the target clock signal has stabilized.

   — When the clock signal is generated with an external resonator (or from an external oscillator) during a reset, ensure that the reset line is only released after full stabilization of the clock signal. Moreover, when switching to a clock signal produced with an external resonator (or by an external oscillator) while program execution is in progress, wait until the target clock signal is stable.

5. Differences between Products

   Before changing from one product to another, i.e. to a product with a different part number, confirm that the change will not lead to problems.

   — The characteristics of an MPU or MCU in the same group but having a different part number may differ in terms of the internal memory capacity, layout pattern, and other factors, which can affect the ranges of electrical characteristics, such as characteristic values, operating margins, immunity to noise, and amount of radiated noise. When changing to a product with a different part number, implement a system-evaluation test for the given product.

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